University of Florida
Department of Electrical and Computer Engineering
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Intelligent Machine Design Lab
Final Written Report

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Table of Contents

Abstract

Ginger is a high-speed obstacle avoidance robot. Ginger is fully autonomous; she requires no controller or other connection to control her and has no external power supply. Ginger uses infrared range finders, sonar range finders, and bump switches to accomplish her task.

Executive Summary

Ginger is an autonomous robot designed to quickly avoid obstacles and stay on a raised surface and/or keep from falling into a lowered surface. If she fails to accomplish this task she will announce her failure and shut off. She uses an Atmel Atmega128 AVR Micro controller called the MAVRIC-II to control all of this.

Ginger is made from incredibly light and durable materials (mainly aluminum, polycarbonate, and whatever the different boards are,) because she is meant for rough play. If she is roughly jostled or struck, falls from a great height, or has something thrown at her she does not suffer damage and continues to perform as programmed.

Introduction

Ginger's primary goal was to establish a simple platform for easy high-speed obstacle avoidance. By simplifying this task future students and robot enthusiasts can have a simple high-speed obstacle avoidance platform from which they can advance other ideas and abilities for their robots.

Integrated System

The basic organization of my robot includes three sonar range finders, two IR range finders, and two bump switches attached to the robot's protective dome. The sonar would have alerted the robot to any oncoming obstacles and told the microprocessor where the obstacles are. The microprocessor would have then told the motor driver which way to turn the robot. The IR range finders worked in this same way, but they have precedence, because they indicate that the robot is nearly passing over a steep edge. They are on the rim of the protective dome and are pointed downward – two inches above the driving surface. Finally, the bump switch acts as a shut off device that also triggers an announcement displayed on the LCD display. This is all done at a high-speed.

Mobile Platform

My robot has a body made of transparent, laser-cut polycarbonate. It moves on two 2" wheels that are molded plastic and have rubber-like, studded tires. The wheels and the tires together are three inches in diameter. There is a third wheel that is able to rotate 360 degrees in its position, which is at the back of the robot. This third wheel was given to me by Anne.

Connected to this mobile platform is a transparent polycarbonate, food storage container manufactured by Rubbermaid and marketed under their Stain Shield™ product line. All of the sensors are housed in and on this container which serves as a protective dome for the robot's electronics. The dome is connected to the robot by .125" standoffs that allow the middle of the container to flex. That flexion is sensed by the bump switches that are attached to aluminum sheet metal cut and shaped into an arch that lies between the top frame of the robot and the protective dome.

Actuation

Ginger moves via a pair of two inch wheels with half-inch, rubber-like tires. This three inch wheel system is powered by twin 290 RPM 12V DC gear head motors from lynxmotion.com that were mounted to the bottom of the frame using lynxmotion's motor mounts.

These motors were controlled by the Sozbots Dual RC H-Bridge Motor Controller – also from lynxmotion.com.

Sensors

My robot has four different types of sensors. It has a bump switch that is connected to a protective dome that covers the robot. When the dome is depressed it activates the bump switch and turns off the robot. I also has IR fastened to the to keep it from falling a great distance. The robot has three sonar range finders that would have been used for high-speed obstacle avoidance, but I could not get them working by the deadline.

Behaviors

My robot has two main behaviors. The primary behavior is to operate a simple "edge_of_the_world" program and not fall from a raised surface. The second behavior is to shut off if it is "caught" and the protective dome is depressed. The robot was intended to have a third behavior, which was high-speed obstacle avoidance using three to eight SRF-04 range finders. This did not happen as I could not get the sonar working by the deadline.

Experimental Layout and Results

I have conducted a number of experiments during the process of designing, assembling, and coding Ginger that are both major and minor in importance to this project.

During the design of the frame in AutoCAD the frame design was rendered in 3D and fitted in AutoCAD to see if the design would work. This had to be done a few times until all the design flaws of the frame were worked out.

Later, there were experiments and tests of each component, board, sensor, circuit setup, mechanism, etc of the robot to make sure that it worked on its own before bringing it into commission for the robot.

The results of most of these experiments were less than ideal at first, but over time things were changed until everything was brought into the robot, except the sonar. The sonar was the last piece of the puzzle. Once that is in place and coded properly my robot will be complete.

Conclusion

My robot manages to entertain while avoiding the edge of a raised surface such as a table. It has brought tears to the eyes of onlookers as it quickly and precariously speeds to a ledge only to quickly stop at it. After it stops it begins to back up from the edge, and in the process, it torques it's entire body forward as if it is throwing itself from the ledge – much to the fright of any and all onlookers. It manages to do all of this very quickly and several times over every minute.

Appendices

GNU GCC C code.

Parts list

Appendix A: Parts List

Part	Supplier	Qty	Cost	Website
Front wheels and plastic wheel mounts	My girlfriend	2	Free	none
Motors	Lynxmotion	2	$16.50	www.lynxmotion.com
Sonar	Advanced Motion	8	$29.00	www.go-advanced.com
IR	Advanced Motion	2	$8.25	www.go-advanced.com
Motor Driver	Lynxmotion	1	$49.95	www.lynxmotion.com
LCD Display	Mike Bonestroo	1	$2.00	
Tail Wheel Assembly Kit	Lynxmotion	1	$10.00	www.lynxmotion.com
Motor Mounts	Lynxmotion	1	$7.95	www.lynxmotion.com
IR connector and wiring	Advanced Motion	2	$1.50	www.go-advanced.com
Microprcoessor board	BDMicro	1	$85.00	http://www.bdmicro.com/mavric-ii/
Rubbermaid Stain Shield Container	Target	1	$6.99	www.target.com
Aluminum Sheet Metal	Lowe's	1	Free	www.lowes.com
4-40 Hexnuts	Jameco	100	$0.023	www.jameco.com
1/4" 4-40 Screws	Jameco	100	$0.019	www.jameco.com
1/4" Aluminum Male/Female Standoffs	Jameco	20	$0.35	www.jameco.com
1/2" Aluminum Male/Female Standoffs	Jameco	20	$0.44	www.jameco.com
On/Off Switch	Lab	1	Free	http://www.mil.ufl.edu/imdl/
Wire	Lab		Free	http://www.mil.ufl.edu/imdl/
Headers	Lab		Free	http://www.mil.ufl.edu/imdl/

Appendix B: C Code.